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MATERIALISM UNTENABLE.

SO LONG as mind and body were considered as two distinct entities which could be dissociated, and having no necessary relation to each other, each could be thought of apart from the other and each was the subject of scientific effort leading to so-called mental science on the one hand and to physical science on the other. Matter was a temporary habitat for mind.

Most of those who dealt with philosophy believed that the science of mind was so much higher in dignity and worth than physical science, that their terminology degraded the latter. Matter was called gross, inanimate, inert. Forces were supposed to be the cause of any physical phenomena. Thus light, heat, electricity, chemical affinity, and vital force were installed as agencies for moving matter thus and thus. Forces enabled matter to act upon other matter at a distance to produce such phenomena as gravitation, magnetism, and so on. Caloric was invented to explain heat-phenomena. It was an imponderable something which matter could absorb and emit. There were several imponderables, all invented to help out the assumption that matter was inert and had no ability in itself to do anything. Whether or not it was the dominating influence of the reigning theology of the time which was accepted by physical philosophers, it is true that the latter with few exceptions accepted it and let go with reluctance every one of these genii which had been summoned to do physical work. After it had been shown by Davy and Count Rumford in the first of this century that heat was a vibratory motion of matter, the fact did not get into text-books on physics for two generations. Once clearly perceived, however, and in that one particular of heat one imponderable was banished and every atom of matter having any temperature at all was endowed with energy, and was able to do something itself. So far it was able with its endowment of energy to act on other matter. But the heat of a mass of matter showed itself in two ways. First, by imparting it to other bodies when they were in contact with the heated body, that is, by what is called conduction, and second, imparting it to other bodies at a distance without contact and apparently irrespective of distance, by a process called radiation. If the body was heated so it would shine, that is, give out light, the latter was found to exhibit interference phenomena of such a peculiar sort as to necessitate the assumption of wave motion in some medium. It was observed, too, that the velocity of the light was nearly two hundred thousand miles in a second.

When Thomas Young worked out the theory of light as a wave-motion in interstellar ether, he met ridicule and contempt in some quarters and was elsewhere ignored. Years after Foucault's crucial experiment proving that light went slower through water than through air or a vacuum the text-books continued to say "There are two theories of light, the corpuscular and the undulatory."

The phenomena necessitated the assumption of a medium filling space and it was called the luminiferous ether to indicate its function as a conductor of light. The study of spectra and photography led some to the conclusion that there were three different kinds of radiations, which they called heat, light, and actinic or chemical rays, as they were supposed to be capable of producing, heating, lighting, and chemical effects respectively. Further researches proved that the only difference there was between these was one of wave-length, that every wave of every length was capable of heating bodies, that photography was possible with waves of all lengths and lastly that what was called light depended altogether upon the structure of the eye, or, in other words, is a physiological effect and not dependent in any way upon a particular kind of wave. This knowledge has profoundly affected theoretical views about many things. It has banished radiant heat, and light, and actinism as forces, and it has banished them as proper terminology for any physical phenomena. So completely is this so that Professor Newcomb has proposed to banish the word light from physical science. There is no such thing, it is but a physiological effect and has no existence at all apart from eyes. The vibratory motions of atoms and molecules of matter which are called heat, set up disturbances in the medium called the ether, and the latter propagates the disturbance as waves with the velocity of one hundred and eighty-six thousand miles in a second. If the vibrations be slow the waves will be long. If they be more rapid the waves will be shorter. What either long or short waves will do depends altogether upon what kind and condition of matter they fall upon. They all originate in matter which is endowed with vibratory energy and in this process the energy is transformed from vibratory in matter to undulatory in the ether. The energy as such is in a new medium and is endowed with new properties.

In like manner electrical phenomena were thought to be indications of a different force of a dual character known as positive and negative. It was attributed to fluids of an imponderable sort that matter could absorb and emit under certain conditions. Since Maxwell's time it has been made evident that electrical phenomena, like heat phenomena, are interactions between common matter and the ether, for waves may be set up in the ether by electrical disturbances in matter, and the waves travel in the ether with the same velocity as those disturbances set up by heat-vibrations.

For this reason light has been called an electro-magnetic phenomenon, for electric waves in the ether have all the characteristics of ordinary waves which can affect the eyes. They can be refracted, reflected, and polarised. Just as any ray of so-called light can be traced back to a vibrating atom or molecule of matter, so may every so-called electric wave be traced back to movements in a mass of matter.

The dual character of the phenomena is apparently due to torsional strain in the ether which may be either right-handed or left-handed. No one now thinks that a fluid of any kind or a force of any kind is needed to account for electrical phenomena.

Magnetism, too, has been traced to molecules. When a current of electricity is made to traverse a coil of wire that surrounds a piece of iron, the latter becomes a magnet and will attract other pieces of iron. It appears as if it was endowed with a quality it did not possess before the current of electricity went through the coil. As a matter of fact the function of the current is simply to arrange the molecules, not to magnetise them; they are no more magnetic with the current than without it, but when the molecules face all one way their individual magnetic qualities or fields, as they are called, conspire together, act in one direction, and if they be fixed in their positions, the mass becomes what is called a permanent magnet, whereas, when the current is stopped, if the molecules be free to assume new positions, the cohesion pressure twists them out of place, and then their fields neutralise each other by overlapping. The point here is that one has no need to assume any force or fluid outside of matter to account for magnetism, and that an electric current does not endow iron with its magnetic quality; it is inalienable, and the strength of magnetic attraction is the measure of ether pressure.

Chemical affinity has been shown by Dewar and Pictet to be dependent upon temperature absolutely. At low temperatures there is no indication of its existence, so in the absence of heat there is no such thing as chemical activity. As a force that has gone along with the rest.

As to force itself, irrespective of any particular manifestation, its existence has been denied by high authorities. The ninth edition of the *Britannica* has not recognised the necessity for giving it any attention. The word "pressure" may be substituted for it in almost every place where it is used, and that word carries with it no suggestion or implication of some extra-material condition that controls phenomena.

Vital force was dismissed a long time ago, and all biological phenomena are believed to have physical and chemical antecedents only.

Having discharged all forces and fluids and imponderables from service there still remain all the phenomena, but matter has to be credited with qualities it was believed not to possess, and instead of being the inert thing it was assumed to be, it turns out that it is loaded with energy and capable of doing many things. Every atom has a hold upon every other atom in the universe, and a change in its position or form or aspect changes in some degree the position, form, or aspect of every other one. The change in position we attribute to gravitation, the change in form to heat, and in aspect to electromagnetism.

When we say that a pound of coal has 14,000 heat-units, we mean that when it combines with oxygen to form carbonic acid gas it gives up heat-energy enough to heat seven tons of water one degree, and as each heat-unit is the equivalent of 778 foot pounds, the working energy of the pound of coal is equal to the product of $778 \times 14{,}000 = 10{,}892{,}000$ foot pounds. That means that the pound of coal and the oxygen have energy enough to raise the pound of coal two thousand miles high, and a mass of matter that can do so much, can hardly be called inert, no matter how helpless it looks. Charcoal is safe to handle, so is sulphur and saltpetre ; mix them together, one has added no energy to them, but gunpowder is not a thing to be trifled with, because it has energy. The molecules are loaded with it, and they are in unstable equilibrium. Bread and butter may be fed to an engine as well as coal or wood ; it is not so efficient as coal pound for pound, and it costs more, but it will serve the same purpose and in the same way, because it is loaded with energy in such shape as to be available for transformation into heat, and this is one of its functions when it is used for food. The science called thermo-chemistry is concerned altogether with the exchanges of energy in the various chemical transformations, and, as before stated, energy is the ability to move matter directly or indirectly. When it produces pressure simply, it is called potential energy; when it produces motion, it is called kinetic energy, but philosophers are persuaded that energy is always kinetic, even when no work is apparently done. This means that the atoms of matter are not passive bodies, but possess energy in other forms than are manifested by temperature and pressures of various sorts, so matter cannot be what it has for so long time been supposed to be, but must be credited with energies and possibilities which the older philosophies denied it to have.

The so-called properties of matter have often been considered as fiat endowments, but many of them, such as hardness, malleability, density, and the like are seen to be qualities of relation. Thus hardness refers to the degree of cohesion that exists between molecules, and the quality of hardness could not be affirmed of an atom. In like manner density means the degree of compactness of molecules. On the other hand, gravity, mass, and elasticity seem to be inherent in every atom and cannot be annihilated by destroying relations. No physical process has been discovered by which an atom can be annihilated or created, and it is commonly thought the atoms of matter are permanent structures with definite dimensions, somewhere in the neighborhood of the one-fifty-millionth of an inch in diameter.

The chemist reckons about seventy different kinds of matter called the elements, each one differing permanently in its inherent qualities from the rest, so it may be identified by its phenomena. Such differences as these different elements exhibit can hardly be imagined to be due to differences in size or shape. One might understand how spheres and cubes and octahedra and other forms could be made of wood, or stone, or brass, and they might be of any size, but the specific density of them all would be the same, and it would not take long to find it out. To assume that the different kinds of atoms were made of as many different kinds of stuff would not help philosophy or science any, and there is no probability in such a supposition. When one feels assured of the existence of the ether and is aware what reaction there is between atomic matter and it, he cannot doubt there must be some intimate relation between them, for the exchange of some kinds of energy is easy while other kinds appear to be unexchangable. Thus there is no evidence that the translatory motion of a mass of matter affects the ether in the slightest degree, or that matter suffers from friction to any appreciable extent, even where a body like a comet moves through it at the rate of four hundred miles a second. The vibratory change of form sets up waves and the energy is absorbed by the ether at once. The ether is said to be frictionless on account of the former fact that translatory motion may be effected without loss of velocity.

That atoms are elastic there is abundant evidence from the spectrum of the elements, for when it is in the gaseous state and has time for vibrations between impacts, each element gives out waves of definite length, indicating definite rates of vibration, the very best evidence of elasticity known. But elasticity phenomena can be duplicated in the easiest manner by the gyroscope and similar machines, which when quiescent present no such quality, but when made to spin show a degree of elasticity in a manner proportionate to the speed of rotation, so if one could for the time assume that an atom was a spinning somewhat he would be able to see in a mechanical way the explanation of its elasticity, and if there were differences of degree in this he would infer there were different rates of rotation.

All have heard of the vortex ring theory of matter. Not every one knows that up to this time it may fairly be said that it is the only theory of matter we have which has any degree of probability at all. The evidences for it are steadily increasing and thus far nothing has appeared to shake confidence in it. This theory assumes that the atoms of matter are vortex rings of ether in the ether. They are permanent structures because they are in a frictionless medium. They possess form, elasticity, polarity, ability to react upon the ether about them, and on the other hand to be acted on by it. They are the embodiment of energy; indeed, abstract their energy and there would no longer be a ring, only free ether with no qualities different from the rest. This view makes an atom a form of energy, a very different thing from an inert thing, indeed the very opposite, and what might be expected of it would depend upon how much ether was in a state of rotation, its rate of rotation and the specific qualities of the ether of which it was composed, all of these are yet unknown, so one cannot deduce atomic phenomena from a knowledge of the ether. Of the latter it is common to speak of it as a continuous or space-filling medium, frictionless, non-molecular, or not made up of discrete parts, homogeneous, or alike in all directions, capable of acting like both a solid and a fluid, of being thrown into a stress, of transmitting vibratory energy at the rate of one hundred and eighty-six thousand miles a second and gravitative energy more than a million times that speed and withal not capable in any way of affecting any of our senses in a direct way. Some have considered it as possessing elasticity and density, yet it is apparent that such elasticity and density cannot be like those properties as we find them in matter, for if density means compactness of molecules it cannot properly be applied to a substance not made of molecules, and if elasticity means ability to recover form after distortion it cannot be applied to something which has neither form nor the possibility of distortion.

It is common for such as have not paid much attention to physical distinctions to speak of the ether as matter, the assumption being that in some way not pointed out it is finer grained than what we call the elements. This will not do. There is no evidence that the ether has any grainedness at all, neither is there any evidence that it possesses one of the fundamental qualities of the elements, namely gravitation. Experience has led to the statement of the law of gravitation, the first part of which is that every particle of matter in the universe attracts every other particle. If there be evidence of the existence of something else in the universe not subject to such attraction it is evidently improper to call it matter, else the statement should read, *some* particles of matter in the universe, etc. Until there be some evidence of a physical sort as exists in abundance for what we call the elements that the ether possesses gravitative property it cannot be allowed to treat of it and make deductions from the assumption for the sake of any philosophical system.

How different the two are in their constitution and properties is well contrasted by Prof. Karl Pearson in his *Grammar of Science*, page 310, where he remarks, "our sense-impressions of hardness, weight, color, temperature, cohesion, and chemical constitution, may all be described by aid of the motions of a single medium, which itself is conceived to have no hardness, weight, color, temperature, nor indeed elasticity of the ordinary perceptual type." When these characteristics have been emptied out from matter whatever be left the residue is not matter of our experience and ought to be called by another name.

Physical knowledge is doubtless far from complete but it has been pursued far enough to make it clear that matter and ether are two radically different substances, and more ; if there be any approach to truth in the proposition that the elements of ordinary matter are forms of vortical motion of ether in the ether, then it follows that the ether existed prior to the elements, for the latter are made of the former. If the ether be the frictionless medium it is assumed to be, then no physical process with which we are acquainted could possibly be the condition for the formation of a single atom, and this makes it philosophically needful to assume some agency radically different from any physical agency in our experience which could act upon the ether, endow it with energy of a particular sort and make permanent structures. In other words, it makes needful the assumption that matter and ether with such forms of energy as come into our experience are not sufficient to account for the physical universe as we find it, and therefore any scheme of philosophy which builds on these alone is a defective one. Such materialism has no warrant from the vortex ring theory of matter.

Whatever may be the truth as to the constitution of matter this much is certain now, namely, that it is not inert in any such sense as has been assumed, its relation to the ether is not yet mechanically explained and the properties of the ether itself cannot be inferred from the properties of matter. Of the properties of matter itself we are not yet fully conversant. The phenomena developed at low temperatures, at high temperatures, and with alternating electrical currents have been so much of a surprise to scientific men that more than ever they have been made aware that matter is more wonderful and its possibilities greater than ever were supposed by any, and there is no reason to suppose the end is reached in discoveries of this sort. If our knowledge of matter be but partial and of a kind to revolutionise former conceptions of it, and if our knowledge of the ether be still less perfect and of a kind not yet correlated with the knowledge of matter, it would seem to be hazardous for any one to limit the possibilities of either, and it would be well for one who undertakes to do this that he should show to others by some experimental work that his fundamental conceptions of his factors were worthy of some confidence.

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